2015 Syllabus

B.Sc. (Agriculture)

II year IV Semester

S.No.	Course No.	Course Title	Credit Hours
1.	AGR 203	Agronomy of field Crops- I	1+1
2.	HOR 211	Production Technology of Fruits and Plantation Crops	2+1
3.	SST 201	Principles and Practices of Seed Production	1+1
4.	SWE 211	Fundamentals of Soil and Water Conservation Engineering	2+1
5.	STA 211	Applied Statistics	1+1
6.	ERG 211	Renewable Energy	1+0
7.	AGR 204	Study Tour	0+1
8.	AEN 202	Economic Entomology and Principles of Pest Management	2+1
9.	PBG 201	Principles of Genetics and Cytogenetics	2+1
10.	SAC 202	Soil Resource Inventory and Problem Soils	1+1
11.	ANM 201	Introductory Nematology	1+1
12.	NSS/NCC 101	National Service Scheme/ National Cadet Corps	Regd. in I Sem
13.	PED 101	Physical Education	
		Total	**14+10=24**

AGR 203 Agronomy of Field Crops – I 1+1

Theory:

Unit - I: Cereals

Rice, Maize, Wheat, Oat, Barley, Rye and Triticale - Origin, geographic distribution, economic importance, soil and climatic requirements, varieties, cultural practices (from land preparation to harvest) and yield.

Unit - II: Millets

Sorghum, Pearl millet, Small millets - Finger millet, Foxtail millet, little millet, Kodo millet, Barnyard millet and Proso millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

Unit - III: Pulses

Redgram, Blackgram, Greengram, Bengalgram, Horsegram, Cowpea, Soybean and Lentil - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

Unit - IV: Oilseeds -I (Kharif)

Groundnut, sesame, sunflower, castor, Origin, and geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Unit - V: Oilseeds -I (Rabi)

Rape seed and mustard, safflower, Linseed, Niger - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices, yield.

Cereals	Rice, maize, wheat, barley, oats, rye and triticale
Millets	Sorghum, pearl millet, finger millet and minor millets
Pulses	Pigeonpea, green gram, black gram, cowpea, Chickpea, lentil and horse gram
Oilseeds	Groundnut, sesame, soybean, sunflower and castor Rapeseed and mustard, safflower and linseed

Practical:

Identification of sugar, fibre, forage - nursery preparation and management for sugarcane and tobacco - main field preparation; Seed treatment techniques - Sowing and manuring –

Seeding equipment's - Estimation of population - After cultivation practices - Study of growth and yield parameters and yield estimation, harvesting of above crops; Fodder preservation techniques - Silage and hay making, Cost and returns - Visit to institutes and industries - Farmers' fields.

Theory - Lecture Schedule:

1. Importance and area, production and productivity of major cereals and millets of India and Tamil Nadu.
2. Importance and area, production and productivity of pulses and oilseeds crops of India and Tamil Nadu.
3. Rice - Origin - geographic distribution - economic importance - varieties - soil and climatic requirement.
4. Rice - cultural practices - yield - economic benefits - Special type of Rice cultivation - Rajarajan 1000 (SRI), Transgenic Rice - Hybrid rice.
5. Maize - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
6. Wheat and Barley - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
7. Oats, Rye and Triticale - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
8. **Mid semester Examination.**
9. Sorghum and Pearl millet - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
10. Finger millet and Minor millets - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
11. Pigeonpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
12. Greengram, Blackgram and Cowpea - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield - Agronomy of rice fallow pulses.

13. Chickpea, Lentil and Horse gram - Origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.
14. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements - varieties, cultural practices yield and economics.
15. Sunflower - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
16. Sesame and Castor - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
17. Rapeseed, Mustard, Safflower, Niger and linseed - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

Practical:

1. Identification of cereals, millets, pulses and oilseed crops in the crop cafeteria.
2. Practicing various nursery types and main field preparation for rice crop.
3. Nursery and main field preparation for important millets, pulses and oilseeds.
4. Acquiring skill in different seed treatment techniques in important field crops.
5. Estimation of plant population per unit area for important field crops.
6. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for cereals and millets.
7. Acquiring skill in field preparation, sowing and manuring of crops under pure and intercropping situations for pulses and oilseeds.
8. Acquiring skill in using seed drill for sowing operations.
9. Acquiring skill in foliar nutrition for important field crops.
10. Observations on growth parameters of cereals and millets.
11. Observations on growth parameters of pulses and oilseeds.
12. Study of yield parameters and estimation of yield in cereals and millets.
13. Study of yield parameters and estimation of yield in pulses and oilseeds.

14. Working out cost and returns of important cereals, millets, pulses and oilseeds crops.
15. Visit to farmers field / research stations to study the cultivation techniques of cereal, millets, pulses and oilseeds.
16. Visit to nearby Agricultural Research Station / Farmer's field.
17. **Practical Examination.**

References:

Ahlawat, I.P.S., Om Prakash and G.S. Saini. 1998. Scientific Crop Production in India. Rama publishing House, Meerut.

Chidda Singh. 1997. Modern techniques of raising field crops. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.

Singh. S.S. 1997. Crop management under irrigated and rainfed conditions. Kalyani Publishers, New Delhi.

E-References:

www.crida.org

www.cgiar.org

www.tnau.ac.in/agriportal

HOR 211 Production Technology of Fruits And Plantation Crops 2+1

Aim

To impart knowledge on the principles of horticulture, propagation and production techniques of tropical, sub tropical, temperate fruit and plantation crops.

Theory

Unit I: **Fundamentals and propagation techniques of fruit crops**

Horticulture – Origin, definitions – role of fruit crops in national economy - pollination mechanism – fruitfulness and causes of unfruitfulness. Propagation – definition – methods - merits and demerits – propagation through seeds - dormancy and methods of overcoming dormancy – vegetative propagation – merits and demerits – cutting, layering, grafting and budding – rootstock influence – stock / scion relationship– micro propagation.

Unit II: Production status and crop production techniques in tropical fruit crops

Scope and importance of fruit crops- classification of fruit crops – area, production, productivity and export potential.

Climate and soil requirements – varieties – propagation - planting density and systems of planting -cropping systems - after care - training and pruning - water, nutrient and weed management –fertigation - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- post harvest management.

Crops: Mango, Banana, Grapes, Citrus (sweet orange, mandarin, acid lime), Papaya, Indian goose berry (Aonla)

Unit III: Crop production techniques in subtropical and temperate fruit crops

Climate and soil requirements – varieties – propagation - planting density and systems of planting -cropping systems - after care - training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- post harvest management.

Crops: Sapota, pomegranate,Guava, Pineapple, Jack, Apple, Pear, Plum.

Unit IV: Status of production, principles of crop production and production technologies in plantation crops

Scope and Importance of plantation crops - area and production- export potential- classification of plantation crops- planting and cropping systems - principles of canopy management and growth regulation.

Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning- water, nutrient and weed management- shade management-intercropping -mulching-cover cropping -harvest- post harvest management and processing

Crops: Tea, coffee, rubber

Unit V: Crop production technologies in plantation crops

Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning- water, nutrient and weed management- shade management-intercropping – multi-tier cropping system-mulching-top working and other special horticultural practices- maturity indices and harvest-post harvest management and processing

Crops: cocoa, cashew, coconut, arecanut, oil palm and palmyrah

Practical

Features of an orchard – Tools, implements and machineries used for horticultural operations - preparation and application of PGR's for propagation and crop regulation - micropropagation, protocol for mass multiplication and hardening. Propagation techniques, selection of planting material, varieties, important intercultural practices for the fruit crops: **mango, banana, grapes, papaya, sapota, guava, Indian goose berry.**

Plantation crops

Tea-Coffee -Rubber -Cocoa and Coconut – Areca nut- Visit to commercial fruit and plantations industries.

Theory schedule

1. Horticulture - Origin, definitions – role of fruit crops in national economy.
2. Flowering, pollination, fruit set in fruit crops - Fruitfulness and causes of unfruitfulness.
3. Propagation – sexual and asexual propagation - Seed propagation – dormancy and measures to overcome seed dormancy.
4. Vegetative propagation – merits and demerits – cutting, layering.
5. Vegetative propagation - Grafting and budding.
6. Rootstock influence – stock / scion relationship in fruit crops.
7. Micro propagation in fruit crops.
8. Scope and importance of fruit crops cultivation - Area, production, productivity and export potential of fruit crops.
9. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning- top working - water, nutrient and weed management of **Mango**
10. Special horticultural techniques - plant growth regulation-GAP - important disorders – maturity indices and harvest - post harvest management of **Mango**
11. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- water and nutrient management – fertigation technique – weed control of **Banana**
12. Special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- post harvest management of **Banana**
13. Climate and soil – varieties - propagation methods - planting and cropping systems-after care – systems of training and pruning and bud forecasting - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Grapes**
14. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation – nutrient deficiencies and important disorders – maturity indices and harvest- post harvest management of **Citrus (Sweet orange)**

15. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation – nutrient deficiencies and important disorders – techniques to rectify – maturity indices and harvest - post harvest management of **Mandarin and Acid Lime**
16. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - special horticultural techniques - plant growth regulation- important disorders – maturity indices and harvest - post harvest management of **Papaya**
17. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Sapota and pomegranate**
18. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Guava**
19. Climate and soil – varieties - propagation methods - planting and cropping systems - after care - water, nutrient and weed management - special horticultural techniques - plant growth regulation- important disorders – maturity indices and harvest –techniques of round the year production of pineapple - post harvest management of **Pineapple and Jack .Value addition technologies for fruit crops.**
20. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest- post harvest management of **Apple.**
21. Climate and soil – varieties - propagation methods - planting and cropping systems - after care- training and pruning - water, nutrient and weed management - special horticultural techniques - plant growth regulation - important disorders – maturity indices and harvest - post harvest management of **Pear and Plum**

22. Scope and Importance of plantation crops - area and production- export potential- classification of plantation crops- planting and cropping systems - principles of canopy management and growth regulation.
23. Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning of tea
24. Water, nutrient and weed management- shade management and harvest- processing of tea
25. Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- training and pruning of coffee.
26. Water, nutrient and weed management- shade management-maturity indices and harvest-processing of coffee.
27. Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems- after care- water, nutrient and weed management -intercropping – tapping system and processing of rubber
28. Climate and soil requirements- varieties- propagation- nursery management- planting density and systems of planting- cropping systems including multitier system - after care-training and pruning- water, nutrient and weed management- shade management– mulching- maturity indices, harvest and processing of cocoa
29. Climate and soil requirements- varieties- propagation- nursery management- planting-high density and systems of planting- cropping systems- after care- water, nutrient and weed management –intercropping- mulching -top working- maturity indices and harvest and processing of cashew
30. Climate and soil requirements- varieties- propagation- nursery management- planting systems- after care- water, nutrient and weed management- intercropping at various ages of plantation – multi-tier cropping system- harvest and post-harvest handling of coconut
31. Climate and soil requirements- varieties- propagation- nursery management- planting-after care- water, nutrient and weed management- intercropping- harvest and post-harvest handling of arecanut

32. Climate and soil requirements- varieties- propagation- nursery management- planting- after care- water, nutrient and weed management- tapping and harvesting of palmyrah.
33. Climate and soil requirements- propagation - planting- water, nutrient and weed management and harvest of oil palm.
34. Value addition in plantation crops.

Practical schedule

1. Features of an orchard – Tools, implements and machineries used for horticultural operations
2. Preparation and application of PGR's for propagation.
3. Micro propagation, protocol for mass multiplication and hardening of fruit crops.
4. Propagation techniques, selection of planting material, varieties, important cultural practices for **Mango**
5. Propagation techniques, selection of planting material, varieties, important cultural practices for **Banana**
6. Propagation techniques, selection of planting material, varieties, important cultural practices for **Grapes**
7. Propagation techniques, selection of planting material, varieties, important cultural practices for **Papaya**
8. Propagation techniques, selection of planting material, varieties, important cultural practices for **Sapota** and **Guava**
9. Crop regulation in fruit crops – Training and Pruning practices, top working and rejuvenation of old trees.
10. Tea- identification of species, nursery practices, training and pruning – processing
11. Coffee - identification of species, nursery practices, training and pruning – processing
12. Rubber - identification of clones, bud wood nursery practices - processing
13. Cocoa - identification of types, clonal nursery practices, training and pruning – processing; Cashew- identification of varieties, propagation techniques, top working- processing

14. Coconut - identification of varieties, mother palm and seed nut selection, nursery practices- management of nutrient deficiencies - processing
15. Arecanut- identification of varieties, mother palm and seed nut selection, nursery practices- management of nutrient deficiencies - processing
16. Visit to commercial fruit and plantation industries.
17. Practical examination

Outcome

- Students will gain knowledge on the fundamentals of horticulture and propagation
- Students will be imparted with wide knowledge on major tropical, a few sub tropical and temperate fruit and plantation crops
- Hands on training on various propagation methods and important cultural practices for major fruit and plantation crops will be provided (Practical)

Reference text books

1. Kumar, N. 2014. Introduction to Horticulture. Oxford & IBH Publishing co. Pvt. Ltd.
2. Chadha, K.L and Pareek, O.P. 1996. (Eds.). Advances in Horticulture. Vols. IIIV. Malhotra Publ. House
3. Kumar, N. 2014. Introduction to Spices, Plantation, Medicinal and Aromatic crops, IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Alice Kurian and Peter, K.V. 2007. Horticulture science series Vol. 08, New India Publishing Agency, New Delhi.
5. Veeeraragavathatham, D and et al.,2004. Scientific fruit culture, Sun Associates, Coimbatore.

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http://www.jhortscib.com

http://journal.ashspublications.org

http://www.actahort.org/

http://www.aphorticulture.com/crops.htm

http://cpcri.nic.in/

http://indiancoffee.org

SST 201 Principles and practices of seed production 1+1

Aim:

To make the students understand the importance of seed quality and principles involved in seed production.

Theory

Unit I - Introduction to seed and seed quality

Seed - definition - Seed structure - Seed development and maturation - Germination -phases of seed germination - Dormancy - types of seed dormancy - Seed senescence - causes of seed senescence - Seed quality characteristics - significance - Classes of seed - Generation system of seed multiplication in seed supply chain .

Unit II - Principles of seed production

Seed replacement rate and varietal replacement - Seed Multiplication Ratio - Seed renewal period - Causes of varietal deterioration and maintenance - Genetic and agronomic principles of seed production - Factors affecting quality seed production - Methods of seed production of varieties and hybrids.

Unit III - Seed production techniques of agricultural crops

Floral biology and pollination behavior - seed production techniques of rice, maize, sorghum and bajra varieties and hybrids - redgram varieties and hybrids - blackgam and greengram varieties - groundnut and sesame varieties - sunflower, castor and cotton varieties and hybrids – Bt cotton.

Unit IV - Seed production techniques of vegetable crops

Floral biology and pollination behavior - seed production techniques of tomato, chillies, brinjal, bhendi, onion, snakegourd, bittergourd, pumpkin, ashgourd, ribbedgourd and bottlegourd varieties and hybrids.

Unit V - Post harvest seed handling techniques

Threshing - methods - Drying - methods of seed drying - advantages and disadvantages -Seed processing – definition - importance - Seed cleaning and grading - upgrading - equipments - working principles - Seed treatment - importance - types - Seed invigouration techniques - seed hardening - seed fortification - seed priming - Seed enhancement techniques - seed coating - seed pelleting.

Practical

Study of seed structure of agricultural and horticultural crops - Seed dormancy - breaking methods - Seed invigouration techniques - hardening and priming - Seed enhancement techniques - seed coating and pelleting - Seed upgradation technique in rice- Acid delinting in cotton - Hybrid seed production techniques - Detasseling in maize - emasculation and dusting in cotton and vegetables - supplementary pollination in rice and sunflower – Practicing pregerminative techniques, enhancing floral ratio and improving seed set in cucurbits - Visit to seed production plot - Identification of physical and genetic contaminants, pollen shedders, partials, shedding tassels, selfed bolls and fruits - Physiological and harvestable maturity indices - Fruit grading - Seed extraction methods in vegetables - tomato, brinjal, chillies, bhendi and cucurbits - Seed cleaning and grading techniques - Detection of seed mechanical injury - Visit to seed processing plant - Seed production planning - Cost benefit ratio of hybrids and vegetables seed production.

Theory Schedule

1. Seed - definition - seed structure - Seed development and maturation
2. Germination - phases of seed germination - Dormancy - types of seed dormancy
3. Seed senescence - causes of seed senescence - seed quality characteristics - significance
4. Classes of seed - Generation system of seed multiplication in supply chain - Seed replacement rate and varietal replacement - Seed Multiplication Ratio - Seed renewal period

5. Causes of varietal deterioration and maintenance - Genetic and agronomic principles of seed production - Factors affecting quality seed production - Methods of seed production of varieties and hybrids
6. Floral biology and pollination behavior - seed production techniques of rice varieties and hybrids.
7. Floral biology and pollination behavior - seed production techniques in maize varieties and hybrids.
8. Floral biology and pollination behavior - seed production techniques of sorghum and bajra varieties and hybrids.
9. Mid semester examination.
10. Floral biology and pollination behavior - seed production techniques of red gram varieties and hybrids - blackgam and greengram varieties - groundnut and sesame varieties.
11. Floral biology and pollination behavior-seed production techniques of sunflower, castor varieties and hybrids.
12. Floral biology and pollination behavior - seed production techniques of cotton varieties and hybrids - Bt cotton - seed production techniques of varieties and hybrids of tomato, brinjal and chillies.
13. Floral biology and pollination behavior - seed production techniques of bhendi and onion varieties and hybrids.
14. Floral biology and pollination behavior - seed production techniques of snakegourd, bittergourd, pumpkin, ashgourd, ribbedgourd and bottlegourd varieties and hybrids.
15. Post harvest handling of seeds - Threshing - methods - Drying - methods of seed drying - advantages and disadvantages.
16. Seed processing - definition - importance - sequence - seed cleaning and grading -equipments (cleaner cum grader) upgrading - equipments (colour sorter, Indented cylinder separator, specific gravity separator, spiral separator, magnetic separator - needle separator -working principles - Seed treatment - importance - types.

17. Seed invigouration techniques - seed hardening - seed fortification - seed priming - Seed enhancement techniques - seed coating - seed pelleting.

Practical schedule

1. Study of seed structure of agricultural and horticultural crops.
2. Seed dormancy breaking methods.
3. Practicing seed invigouration techniques - seed hardening.
4. Practicing seed invigouration techniques - seed priming.
5. Practicing seed enhancement techniques - seed coating and seed pelleting.
6. Seed upgradation technique in rice- Acid delinting in cotton.
7. Detasseling techniques for hybrid seed production in maize.
8. Emasculation and dusting techniques for hybrid seed production in cotton and vegetables.
9. Hybrid seed production techniques - supplementary pollination in rice and sunflower.
10. Practicing pre-germinative techniques , enhancing floral ratio and improving seed set in cucurbits
11. Visit to seed production plot - identification of physical and genetic contaminants, pollen shedders and partials, shedding tassels, selfed bolls and fruits.
12. Determination of physiological and harvestable maturity indices.
13. Fruit grading and seed extraction methods in vegetables - tomato, brinjal, chillies, bhendi and cucurbits.
14. Seed cleaning and grading techniques and detection of seed mechanical injury.
15. Visit to seed processing unit.
16. Seed production planning and determination of cost benefit ratio of hybrids and vegetables seed production.
17. Final practical examination.

Out come

The students will gain knowledge about the various techniques of quality seed production, processing and seed quality enhancement.

References

Standard text books

1. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
2. Bhaskaran, M. *et al.,* 2004. Principles of seed production. Scientific Publishers, Ludhiana.

Online references

1. www.fao.org
2. www.seednet.gov.in
3. www.agricoop.nic.in
4. www.online library.willey.com
5. www.sciencedirect.com

e-journals

1. Seed Science Research (www.jgateplus.com)
2. Seed Science and Technology (www.jgateplus.com)

e- books

1. "Seeds", Baskin, Carol. Academic Press. (Elsevier e-books) (ISBN No. 9780124166776).
2. *"Seeds" Derek Bewley, Kent. (Springer e- books) (www-link-springer.com) (ISBN NO. 978-1-4614-4693-4)*

SWE 211 Fundamentals of Soil and Water Conservation Engineering 2+1

Scope

To gain knowledge and skills on measurement of land, surveying and leveling, different irrigation methods, pumping of water, soil and water engineering concepts

Objective

To impart the basics of soil and water conservation engineering to the undergraduate students

Theory

Unit I Surveying

Surveying and levelling – chain, compass and plane table survey – levelling – land measurement and computation of area – Simpson's rule and Trapezoidal rule.

Unit II Soil erosion

Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion - water erosion - causes - erosivity and erodibility - mechanics of water erosion - splash, sheet, rill and gully erosion - ravines - land slides – wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep

Unit III Soil conservation and watershed management

Erosion control measures for agricultural lands – biological measures – contour cultivation – strip cropping – cropping systems – vegetative barriers - windbreaks and shelterbelts - shifting cultivation - mechanical measures – contour bund – graded bund – broad beds and furrows – basin listing – random tie ridging – mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall – Rain water harvesting – insitu soil moisture conservation – Runoff Computation - runoff water harvesting — Farm ponds and percolation ponds - storage and its use for domestic and ground water recharge. Gully control structures -Check dams – Temporary and permanent. Watershed concept – Integrated approach and management

Unit IV Irrigation and drainage

Irrigation - measurement of flow in open channels - velocity area method - rectangular weir - Cippoletti weir - V notch - orifices - Parshall flume - duty of water - irrigation efficiencies - conveyance of irrigation water - canal lining - underground pipe line system - surface irrigation methods - borders, furrows and check basins - drip and sprinkler irrigation– agricultural drainage - surface drainage systems – sub-surface drainage systems - drainage coefficient-design of open ditches.

Unit V Wells and Pumps

Groundwater occurrence – aquifers – types of wells and sizes – pump types – reciprocating pumps – centrifugal pumps – turbine pumps – submersible pumps – jet pumps – airlift pumps – selection of pumps – operation and their maintenance.

Practical

Study of survey instruments - chains and cross staff surveying - linear measurement - plotting and finding areas. Compass survey - observation of bearings - computation of angles- radiation, intersection. Levelling – fly levels – determination of difference in elevation.– Computation of area and volume - Contouring. Design of contour bund and graded bund. Visit to CSWCRTI, Ooty. Drip systems and Sprinkler irrigation systems. Problems on water measurement. Problems on duty of water, irrigation efficiencies. Problems on water requirement - agricultural drainage. Study of different types of wells and its selection. Study of pumps and its selection.

Lecture schedule

1. Introduction - land surveying - uses in agriculture.
2. Chain cross staff and compass surveying - computation of angles.
3. Radiation, intersection and traversing.
4. Dumpy level - setting, observation and tabulation of readings - computation of land slope - difference in elevation.
5. Computation of area and volume – Simpson’s rule and Trapezoidal rule.
6. Soil Erosion – causes and evil effects of soil erosion – geologic and accelerated erosion

7. Water erosion - causes - erosivity and erodibility - mechanics of water erosion
8. Splash, sheet, rill and gully erosion - ravines - land slides
9. Wind erosion - factors influencing wind erosion - mechanics of wind erosion – suspension, saltation, surface creep
10. Effects of water and wind erosion
11. Erosion control measures for agricultural lands – biological measures – contour cultivation – strip cropping - Cropping systems – vegetative barriers - Windbreaks and shelterbelts - shifting cultivation
12. Mechanical measures – contour bund – graded bund - Broad beds and furrows – basin listing – random tie ridging
13. Mechanical measures for hill slopes – contour trench – bench terrace – contour stone wall
14. Rain water harvesting – insitu soil moisture conservation – Runoff Computation - runoff water harvesting
15. Farm ponds and percolation ponds - storage and its use for domestic and ground water recharge
16. Gully control structures -Check dams – Temporary and permanent
17. Watershed concept – Integrated approach and management
18. Mid semester examination.
19. Irrigation - measurement of flow in open channels - velocity area method
20. Rectangular weir - Cippoletti weir - V notch
21. Orifices - Parshall flume
22. Duty of water - irrigation efficiencies
23. Conveyance of irrigation water - canal lining
24. Underground pipe line system
25. Surface irrigation methods - borders, furrows and check basins
26. Components of drip and sprinkler irrigation system
27. Agricultural drainage – need - surface drainage systems

28. Surface drainage systems - drainage coefficient
29. Groundwater occurrence – aquifers types
30. Types of wells and sizes
31. Pump types – reciprocating pumps – centrifugal pumps
32. Turbine pumps – submersible pumps
33. Jet pumps – Airlift pumps
34. Selection of pumps – operation and their maintenance.

Practical schedule

1. Study of survey instruments - chains - compass - plane table - dumpy level.
2. Chains and cross staff surveying - linear measurement - plotting and finding areas.
3. Compass survey - observation of bearings - computation of angles.
4. Compass - radiation, intersection.
5. Levelling – fly levels – determination of difference in elevation.
6. Computation of area
7. Computation of volume - Contouring
8. Design of contour bund and graded bund.
9. Visit to CSWRTI, Ooty.
10. Drip Irrigation systems.
11. Sprinkler irrigation system
12. Problems on water measurement.
13. Problems on duty of water, irrigation efficiencies.
14. Problems on water requirement - agricultural drainage.
15. Study of different types of wells and its selection.
16. Study of pumps and Selection of pumps.
17. Practical examination.

Text books

1. Basak, N.N. 2008. Surveying and Levelling. 25th reprint. Tata Mc-Graw Hill Publishing Company Ltd
2. Michael, A.M. and Ojha, T.P. 2008. Irrigation Theory and Practice. Second Edition. Vikas Publication House, New Delhi

e- References

- http://nptel.ac.in/courses/105107122/13
- http://soilwater.okstate.edu/courses/lectures-powerpoint

STA 211 **Applied Statistics** **1+1**

Scope of the Course

Students will acquire knowledge in basis techniques that are applicable to agricultural sciences. Further the course will provide them good introduction to various statistical analysis used in biological sciences.

Objective

To understand and apply fundamental concept of statistical applications in biology and to acquire about theoretical concept of descriptive statistics, testing of hypothesis, correlation, regression and basic design of experiments.

Theory

Unit I: Descriptive Statistics

Introduction – Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode –Merits and demerits. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation - Skewness and kurtosis – Merits and demerits.

Unit II: Sampling Theory and Probability Distributions

Sampling theory – population – sample – parameter and statistic – sampling distribution - sampling vs complete enumeration –Types of sampling - simple random sampling – selection using random numbers – Stratified - Systematic sampling.

Probability distributions – Discrete distributions: Bernoulli, Binomial and Poisson. Continuous distribution: Normal distribution – definitions and properties.

Unit III: Testing of hypothesis

Null and alternative hypothesis – types of errors - critical region and tests of significance. Large sample test – single mean and difference between two means – single proportion and difference between two proportions.

Small sample tests – F-test - t-test for testing the significance of single mean – independent and paired t test – chi square test for testing the association of r x c contingency table.

Unit IV: Correlation and Regression

Correlation – Scatter diagram - Karl Pearson's correlation coefficient – Spearman's rank correlation - computation and properties.

Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient.

Unit V: Analysis of Variance and Experimental Designs

Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs – Completely Randomized Design (CRD) – Randomized Block Design (RBD) – Latin Square Design (LSD).

Text Books

I. Rangaswamy, R. 2009, A Text book of Agricultural Statistics, Wiley Eastern Limited, New Delhi.

II. Dhamu. K. P and K. Ramamoorthy. 2007. Statistical Methods. Agrobios (India), Jodhpur.

References

1. Gupta.S.C and V.K.Kapoor. 1977. Fundamentals of Applied Statistics. Sultan Chand & Sons, New Delhi.
2. Gupta S.P, Statistical Methods, 2004, Sultan Chand & Sons, New Delhi.
3. S.C. Gupta & V.K. Kapoor. 2003. Fundamentals of Mathematical Statistics. Sultan Chand & Sons, New Delhi.
4. Panse. V. G and P.V. Sukhatme. 1954. Statistical methods for agricultural workers. ICAR, New Delhi.
5. Dhamu. K. P and K. Ramamoorthy. 2009. Fundamentals of Agricultural Statistics. Scientific Publishers (India), Jodhpur.
6. Kailasam. G and R.Gangaiselvi. 2010. Applied Statistics. Kalyani Publishers. New Delhi.

Theory Schedule

1. Introduction – Measures of central tendency: arithmetic mean, geometric mean, harmonic mean, median and mode –Merits and demerits. TBI 1-5, TBI 25 - 35
2. Measures of dispersion: Range, Quartile deviation, Mean deviation, standard deviation, and coefficient of variation - Skewness and kurtosis. TBII 41 – 48
3. Sampling theory – population – sample – parameter and statistic – sampling distribution - sampling vs complete enumeration –Types of sampling - simple random sampling – selection using random numbers Stratified - Systematic sampling. TBII 316 - 321
4. Probability distributions – Discrete distributions: Bernoulli TBI 55 - 57
5. Binomial and Poisson distribution TBI 58 - 61
6. Continuous distribution: Normal distribution TBI 55 - 57
7. Null and alternative hypothesis – types of errors - critical region and tests of significance. TBII 16-17
8. Large sample test – single mean and difference between two means. Single proportion and difference between two proportions. TBII 20-24
9. **Mid Semester Examination**
10. Small sample tests – F-test - t-test for testing the significance of single mean TBII 26-28
11. independent and paired t test TBII 29-38
12. chi square test for testing the association of r x c contingency table. TBII 43-45
13. Correlation – Scatter diagram - Karl Pearson's correlation coefficient – Spearman's rank correlation - computation and properties. TBI 142 – 145
14. Regression – simple linear regression – fitting of simple linear regression equation – properties of regression coefficient. 157 - 165
15. Analysis of Variance (ANOVA) – assumptions – one way and two way classifications. Basic principles of experimental designs. TBI 227 - 231
16. Completely Randomized Design (CRD) – Randomized Block Design (RBD). TBI 269 - 284
17. Latin Square Design (LSD). TBI 315 - 320

Practical schedule

1. Computation of arithmetic mean, geometric mean, harmonic mean, median and mode
2. Computation of range, standard deviation, variance, coefficient of variance
3. Selection of sample using simple random sampling method
4. Simple problems in Bernoulli distribution
5. Simple problems in Binomial distribution and Poisson distribution
6. Simple problems in Normal distribution
7. Large sample test – test for single proportion and difference between two proportions

8. Large sample test – test for single mean and difference between two means
9. Small samples test – t-test for single mean – t test for difference between two sample means (equal variances only)
10. Paired t-test
11. Chi square test
12. Computation of Karl Pearson's correlation coefficient
13. Fitting of simple linear regression equation y on x – correlation and regression using MS Excel functions
14. Analysis of Completely Randomised Design (CRD) – for equal replications only
15. Analysis of Randomised Block Design (RBD)
16. Analysis of Latin Square Design (LSD) – analysis of CRD, RBD and LSD
17. **Final Practical Examination**

Web resources

1. http://www.statistics.com/resources/glo.ssary/
2. www.statsoft.com
3. http://www.iasri.res.in/ebook/EB_SMAR/index.htm
4. www.stats.gla.ac.uk/steps/glossary/index.html
5. http://davidmlane.com/hyperstat/
6. http://www.stattrek.com/
7. http://www.businessbookmall.com/Statistics Internet Library.htm
8. http://www.stat-help.com/
9. www.statsci.org/jourlist.html

ERG 211 Renewable Energy 1+0

Unit I- Biochemical Energy Conversion

Energy crisis – Renewable energy sources – significance – potential - achievements in India – Biomass – methods of energy conversion -Biogas technology – classification - types -factors affecting biogas plants- alternate feedstocks – applications - biodigested slurry and enrichment.

Unit II – Thermochemical Energy Conversion

Briquetting –methods- advantages and disadvantages -combustion –definition- Improved chulhas – single pot – double pot – conventional chulha – biomass gas stove. Pyrolysis – methods for charcoal production- biochar production- comparion of slow and fast pyrolysis. Gasification – chemistry – types – updraft gasifier -downdraft gasifier – working principles.

Unit III – Solar Energy Conversion

Solar Energy – characteristics - types of radiation – solar constant-solar thermal devices – solar water heater – solar cooker – evacuated tube collector – working principles and applications-solar PV systems – principle – solar lantern - water pumping -solar driers – natural and forced convection types – solar tunnel drier – working principles and operation.

Unit IV- Wind and other Alternate Energy Sources

Wind mills – types – horizontal and vertical axis – components – working principles – applications .Energy from ocean-waves-tides.Geothermal energy sources – principles and operation-drying of agricultural products. Biofuels – importance – Biodiesel production method – flowchart – by products utilization

1. Energy crisis – renewable energy sources – significance – potential and achievements in India – energy requirements of agricultural and horticultural crops.
2. Biomass – methods of energy conversion – biochemical conversion methods – thermochemical conversion methods.
3. Biogas technology – classification - types of biogas plants – KVIC and Deenabandhu model biogas plants – factors affecting biogas plants.
4. Alternate feedstocks for biogas production – applications of biogas cooking, lighting and engine operations - biodigested slurry and enrichment.
5. Briquetting – MED – VED – methods – need for briquetting - benefits of biomass briquettes.
6. Combustion – improved chulha – single pot – double pot – conventional chulha – biomass gas stove – constructional features – principles and applications.
7. Pyrolysis – methods for charcoal production –biochar production– comparison between slow and fast pyrolysis.
8. Gasification – chemistry – types – updraft gasifier – working principles operations – application
9. Mid semester examination

10. Downdraft gasifier – working principles – operation and applications.
11. Solar energy – characteristics of solar radiation - types of radiation – solar constant
12. Solar thermal devices – solar water heater – solar cooker – evacuated tube collector – working principles and applications.
13. Solar PV systems – principle – solar lantern - water pumping applications.
14. Solar driers – natural and forced convection types – solar tunnel drier – working principles and operation.
15. Wind mills – types – horizontal and vertical axis – components – working principles – applications.
16. Energy from ocean, waves, tides. Geothermal energy sources – principles and operation.
17. Biofuels – importance – biodiesel production method – flowchart – by products utilization

AGR 204 **Short Tour** **0+1**

The students will undertake the short tour during third semester for seven days covering KVK's, Research stations, Sister campuses and ICAR institutes in the southern part of Tamil Nadu. The study tour will provide an exposure to the students to know about the soil, climatic

conditions and cropping patterns in the respective agro-climatic zones. The students will also have first-hand information on latest technologies on various crops and allied activities.

AEN 202 Economic Entomology And Principles Of Insect Pest Management 2+1

Aim: To impart knowledge on the economically important insects and principles of insect pest management, including concept and components of IPM

Theory

Unit I: Economically important insects

Classification of insects based on economic importance - Apiculture - Bee species – comparison- castes of bees, bee behaviour and bee dance; Apiary management practices – bee pasturage, foraging, seasonal variations; Bee products – properties and uses; Effect of agricultural inputs on bee activity – pesticide poisoning; Lac insect- biology-strains-natural enemies of lac insect and lac products; Weed killers, pollinators, scavengers and soil builders -Household pests, human pests, cattle and poultry pests

Unit II: Insect Ecology

Balance of life in nature – population dynamics – role of abiotic and biotic factors. Bioresources in ecosystem. Life table – interspecific and intraspecific relationships – pests – definition and categories – pest outbreak – factors governing pest outbreak– pest monitoring, surveillance and forecasting. Economic Threshold Level – Economic Injury Level.

Unit III: Components of pest management

Principles of Pest Management- Cultural, Physical, Mechanical, Ecological engineering methods, Resistant varieties in pest management, parasitoids, predators and microbial agents in pest management and biological control of weeds. Bio safety of introduced parasitoids, predators and entomopathogens. Legal methods – definition – pest introductions – quarantine – phytosanitary certificate – pest legislation. Pesticides – insecticides – history, classification. Semiochemicals – allomones – kairomones – pheromones- semiochemicals in pest management. Sterile male technique – chemosterilants, insect growth regulators – moult inhibitors – Juvenile Hormone mimics – antifeedants and repellents. Pesticide application technology. Impact of pesticides in agro-ecosystem, compatibility, safety and hazards in the use of pesticides – pesticide poisoning. Impact of global warming on pests. Natural pesticides. Biotechnology in pest management. Bio safety of transgenic plants.

Unit IV: Integrated Pest Management

Integrated Pest Management – Issues and options – Ecofriendly Integrated Pest Management – Indigenous/Traditional technologies.

Practical

Identification, morphology and structural adaptations in honey bees. Bee keeping appliances, bee enemies and diseases. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products. Study of house hold, human, cattle and poultry pests. Study of useful insects- Pollinators, weed killers, scavengers and soil builders. Symptoms and types of damage caused by insect pests. Assessment of insect population and their damage in field crops. Cultural, mechanical and physical control of insects. Identification and mass culturing of different types of parasitoids, predators and entomopathogens. Behavioral approaches in pest management – Pheromone traps, light traps, sticky traps and others. Pesticide formulations and toxicity

parameters. Pesticide application techniques. Preparation of spray fluids and botanicals for field application. Plant protection appliances.

Theory lecture schedule:

1. Economic classification of insects
2. Bee species – comparison – castes of bees – bee behaviour and bee dance
3. Apiary management practices – bee pasturage – foraging – seasonal variations.
4. Bee products – their properties and uses
5. Effect of agricultural inputs on bee activity – pesticide poisoning
6. Lac insect- biology-strains-Natural enemies of lac insect and lac products
7. Weed killers, pollinators, scavengers and soil builders
8. Household, human, cattle and poultry pests
9. Insect ecology – definition – balance of life in nature – reproductive potential and environmental resistance
10. Population dynamics – role of biotic factors – competition – parasitoids and predatots. Life table – Interspecific and intraspecific relationship
11. Abiotic factors – physical, nutritional and host plant associated factors on insect population. Bioresources in ecosystems
12. Pests – definition, categories and causes for outbreak of pests. Losses caused by pests
13. Pest monitoring – pest surveillance and forecasting – objectives, survey, sampling techniques and decision making. Economic Threshold Level and Economic Injury Level. Factors influencing Economic Injury Level and Economic Threshold Level
14. Pest Management – definition – need – objectives, requirements for successful pest management programme. Components of pest management
15. Cultural methods – definition – characteristics, requisites – farm level practices and community level practices, advantages and disadvantages- Ecological Engineering in pest management
16. Physical methods – definition – use of heat, moisture, light, electromagnetic energy and sound energy – Mechanical methods – definition – mechanical destruction and exclusion – merits and demerits
17. Midsemester examination
18. Host plant resistance – types and mechanisms of resistance and role of host plant resistance in pest management
19. Biological control – definition, parasitoids and predators and their role in pest management

20. Microbial control – viruses, bacteria, fungi, protozoa and nematodes and their role in pest management, Biological control of weeds, Bio safety of introduced parasitoids, predators and entomopathogens
21. Legal methods – definition – pest introductions – quarantine – phytosanitary certificate – pest legislation
22. Chemical control – definition – history of insecticide development – toxicity parameters – ideal qualities of an insecticide
23. Classification of insecticides based on mode of entry, mode of action and chemical nature
24. Mode of action of organophosphates, carbamates, synthetic pyrethroids, neonicotinoids, diamides and avermectins

25. Insecticides Act 1968 – insecticide residues and waiting periods, role of pesticides in pest management, insecticide resistance management
26. Semiochemicals – definition – intraspecific semiochemicals – allomone, kairomone, synomone and apneumone
27. Interspecific semiochemicals – pheromone, sex pheromone, alarm and trail marking pheromone. Pheromones in Integrated Pest Management
28. Sterility methods – definition – principles – methods – requirements and limitaitons.
29. Insect growth regulators – moult inhibitors – Juvenile Hormone mimics – mode of action and uses. Insect antifeedants and repellents – mode of action, groups and uses
30. Botanicals and Biotechnological approaches in pest management – bio safety of transgenic plants
31. Pesticide application technology – principles and methods
32. Pesticide compatibility, safety and hazards – antidotes – safe handling – impact of pesticides on agroecosystems. Impact of global warming on pests
33. Integrated Pest Management – history, principles and strategies – relationship between different components and economics
34. Integrated Pest Management : Issues and options. Eco friendly Integrated Pest Management – Indigenous/traditional technologies in Integrated Pest Management

Practical schedule:

1. Identification, morphology and structural adaptations in honey bees
2. Bee keeping appliances, bee enemies and diseases
3. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products

4. Study of house hold, human, cattle and poultry pests
5. Study of useful insects-Pollinators, weed killers, scavengers and soil builders
6. Symptoms and types of damage caused by insect pests
7. Assessment of insect population and their damage in rice, cotton and brinjal
8. Cultural, mechanical and physical control of insects
9. Identification and mass culturing of different types of parasitoids
10. Identification and mass culturing of different types of predators

11. Identification and mass production of entomopathogens
12. Behavioral approaches in pest management – Pheromone traps, light traps, sticky traps and others
13. Pesticide formulations and toxicity parameters
14. Pesticide application techniques
15. Preparation of spray fluids and botanicals for field application
16. Plant protection appliances
17. Final Practical examination

Assignment

- Collection and submission of 25 herbaria of symptom of insect damage

Outcome/Deliverables:

The students gain knowledge on productive and harmful insects as well as the principles of insect pest management, including concept and components of IPM

References:

A.Text Book:

1. David, B.V. and V.V. Ramamurthy. 2011. *Elements of Economic Entomology*, Namrutha Publications, Chennai, 386 p. {ISBN: 978-81-921477-0-3}

B.Reference Books:

1. Pedigo, L.P. and M.E.Rice.1996. *Entomology and Pest Management.* Prentice-Hall of Idia Pvt Ltd,_New Delhi. 812p. {ISBN-978-8120338869}
2. Dhaliwal, G.S. and R.Arora. 2001. *Integrated Pest Management – Concepts and approaches*. Kalyani publishers, New Delhi. 427p. {ISBN: 81-7663-904-4}

Supplementary references:

1. Dhaliwal, G.S. and Ramesh Arora. 1998. *Principles of Insect Pest Management.* Kalyani Publishers, New Delhi.
2. Metcalf, C.K. and W.P. Flint. 1970. *Destructive and Useful Insects - Their Habits and Control.* Tata McGraw Hill Pub. Co., New Delhi
3. Srivastava, K.P. 2003. *A text book of Applied Entomology. Vol. I & II*. Kalyani Publishers.
4. Dhaliwal, G.S. and B.Singh. 1998. *Pesticides – The Ecological Impact in Developing Countries.* Commonwealth Publishers, New Delhi.
5. Yazdani G.S. and M.L. Agarwal. 1979. *Elements of Insect Ecology.* Naroji Publishing House, New Delhi.

Web resources

1. http://www.sristi.org/hbnew
2. http://www.ncipm.org.in/recent-publications.htm
3. http://www.ipmnet.org

PBG 201 Principles of Genetics and Cytogenetics 2+1

Aim

The fundamental concepts of Genetics and Cytogenetics will be exposed to the students quoting classical examples

SYLLABUS FOR THEORY

Unit I: Cytology

Brief history of developments in genetics and cytogenetics; Physical basis of heredity: Structure and function of cell and cell organelles – Differences between Prokaryotes and Eukaryotes. Cell division – mitosis, meiosis and their significance, cell cycle - zygote formation and embryo development - identical and fraternal twins. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram – chromosome banding; Types of chromosomes based on position of

centromere, based on structure and function: based on the role in sex determination, normal and special chromosomes - polytene, lampbrush, Other types of chromosomes - B, ring and isochromosomes; Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications; Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Nondisjunction - Klinefelter syndrome and Turner syndrome; Definition of eugenics and euthenics; Polyploid - auto and allopolyploids, their characters; evolution of wheat, Triticale, cotton, tobacco, Brassicas.

Unit II: Mendelian laws and modifications of Mendelian laws

Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid. Chromosomal theory of inheritance. Allelic interactions – Dominance vs. recessive, complete dominance, codominance, incomplete

dominance, over dominance. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1) ii.) Recessive epistasis (9:3:4) iii.) Duplicate and additive epistasis (9:6:1) iv.) Duplicate dominant epistasis (15:1) v) Duplicate recessive epistasis (9:7) vi.) Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i) to (vi). Lethal genes, Pleiotrophy, penetrance and expressivity, phenocopy: Multiple alleles, blood group in humans, coat colour in rabbits, self incompatibility in plants; pseudo alleles, isoalleles.

Unit III: Quantitative inheritance, Linkage and Crossing over

Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Types of gene action controlling quantitative traits. Linkage - coupling and repulsion; Experiment on Bateson and Punnet – Chromosomal theory of linkage of

Morgan – Complete and incomplete linkage, Linkage group. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over. Strength of linkage and recombination; Two point and three point test cross. Double cross over, interference and coincidence; genetic map, physical map.

Unit IV: Sex determination, sex linkage and cytoplasmic inheritance

Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – *Melandrium,* papaya, maize. Genic balance theory of Bridges, quantitative theory, hormonal theory, barr bodies, metabolic differentiation theory; Gynandromorphs – sex reversal in chicken. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - iojap gene of maize, cytoplasmic male sterility in rice, kappa particles of paramecium - plasmid and episomic inheritance.

Unit V: Modern concept of genetics and mutation

DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment. Structure of DNA – Watson and Crick model – Central dogma of life. Proof for semi conservative method of DNA replication; Models of DNA replication; RNA types - mRNA, tRNA, rRNA; Genetic code, protein synthesis; Regulation of gene expression – operon model of Jacob and Monad; Structural genes and regulator genes. Cistron, muton and recon; Complementation test; exons, introns – split genes –Transposable genetic elements- Ac - Ds system in maize. Functional genomics, Metagenomics, Transcriptomics, Proteomics, Metabolomics and Phenomics. Mutation – characteristics of mutation – micro and macro mutation – ClB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

SYLLABUS FOR PRACTICAL

Study of microscopes – Preparation of fixatives and stains – pre treatment of materials for mitosis and meiosis – study of mitosis and meiosis. Study of genetic ratios of – monohybrid, dihybrid – incomplete dominance. Gene interaction - multiple alleles and multiple factors. Study of linkage, estimation of strength of linkage and recombination frequency in two point and three point test cross data and F_2 data – Drawing of genetic map – interference and coincidence

Theory schedule

1. Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics.
2. Physical basis of heredity: Structure and function of cell and cell organelles – Differences between Prokaryotes and Eukaryotes.
3. Cell division – mitosis, meiosis and their significance, cell cycle; zygote formation and embryo development - identical and fraternal twins.
4. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram – chromosome banding.
5. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes - polytene, lampbrush, based on the role in sex determination: autosomes and allosomes, Other types of chromosomes - B, ring and isochromosomes.
6. Chromosomal aberration: Variation in chromosome structure – deletion, duplication, inversion and translocation – genetic and cytological implications.
7. Chromosomal aberration: Variation in chromosome number – euploid, aneuploid, types of aneuploids and their origin; Nondisjunction - Klinefelter syndrome and Turner syndrome; Definition of eugenics and euthenics.
8. Polyploid - auto and allopolyploids, their characters; meaning of genome; evolution of wheat, Triticale, cotton, tobacco, *Brassica*
9. Pre-Mendelian ideas about heredity – Vapour and fluid theory, Magnetic power theory, Preformation theory, Lamarck's theory, Darwin's theory, Germplasm theory and Mutation theory.
10. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work
11. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.

12. Chromosomal theory of inheritance. Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance, over dominance.

13. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – i.) Dominant epistasis (12:3:1)

14. ii.) Recessive epistasis (9:3:4) iii.) Duplicate and additive epistasis (9:6:1).

    iv.) Duplicate dominant epistasis (15:1)

15. v) Duplicate recessive epistasis (9:7) vi.) Dominant and recessive epistasis (13:3); Summary of epistatic ratios (i) to (vi).

16. Lethal genes, Pleiotrophy, penetrance and expressivity, phenocopy: Multiple alleles, blood group in humans, coat colour in rabbits, self incompatibility in plants; pseudo alleles, isoalleles.

17. **Mid Semester Examination**

18. Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour.

19. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Types of gene action controlling quantitative traits.

20. Linkage - coupling and repulsion; Experiment on Bateson and Punnet – Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group.

21. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over.

22. Strength of linkage and recombination; Two point and three point test cross.

23. Double cross over, interference and coincidence; genetic map, physical map.

24. Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination- different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – *Melandrium*, papaya, maize.

25. Genic balance theory of Bridges, quantitative theory, hormonal theory, barr bodies, metabolic differentiation theory; Gynandromorphs – sex reversal in chicken

26. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance.

27. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - iojap gene of maize, cytoplasmic male sterility in rice, kappa particles of paramecium - plasmid and episomic inheritance.

28. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.

29. Structure of DNA – Watson and Crick model – Central dogma of life

30. Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication.

31. RNA types - mRNA, tRNA, rRNA; genetic code, protein synthesis - transcription. Translation

32. Regulation of gene expression – operon model of Jacob and Monad; Structural genes and regulator genes. Cistron, muton and recon;

33. Complementation test; exons, introns – split genes – Transposable genetic elements - Ac - Ds system in maize - Functional genomics, Metagenomics, Transcriptomics, Proteomics, Metabolomics and Phenomics

34. Mutation – characteristics of mutation – micro and macro mutation – ClB technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

Final theory examination

Practical Schedule

1. Use of microscopes
2. Principles of killing and fixing; preparation of stains and preservatives.
3. Study of behavior of chromosomes in mitosis.
4. Study of the mitotic phases in root tips of onion / *Aloe sp*.
5. Procedure for fixing and observing different meiotic phases in the inflorescence of rice/maize.

6. Procedure for fixing and observing different meiotic phases in the inflorescence in pearl millet/ sorghum/ /horticultural crop/forest tree.
7. Repetition of meiotic studies in maize/ sorghum/ pearl millet/ forest tree and making temporary and permanent slides.
8. Observation of bivalents, trivalents, quadrivalents and chromosome banding.
9. Principles of dominance, recessive, back cross, test cross, incomplete dominance, codominance and lethal factor; Chi square test; Monohybrid genetic ratio with dominance, with incomplete dominance and test cross.
10. Dihybrid ratio with dominance, with incomplete dominance and test cross
11. Simple interaction of genes-comb character in fowls; Dominant epistasis.
12. Recessive epistasis, Duplicate and additive epistasis.
13. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
14. Multiple alleles and polygenic inheritance
15. Estimation of linkage with F_2 and test cross data; Coupling and repulsion.
16. Problems on two point test cross and three point test cross; Working out interference, coincidence and drawing genetic maps.
17. **Final Practical examination.**

Outcome

- Basic principles of inheritance and modern concepts of genetics will be exposed to students

References

- Gupta P.K., 1997. Cytogenetics. Rastogi Publications, Meerut
- Verma,P.S. and V.K.Agarwal. 2007. Genetics. S.Chand and Company Ltd./ New Delhi.
- Stansfield, W.D.1990. Theory and problems of genetics. Mc-Graw Hill Book Co.,New York
- Pundhan singh. 2014. Elements of Genetics. Kalyani Publishers

Further reading

- Benjamin Lewin. 2005. Genes IX Oxford University Press, Oxford.
- Russel, P.J. 2000. Fundamentals of genetics. Addition Wesley Longman Publishers, USA
- Daniel Sundararaj, G. Thulasidas and M.Stephen Dorairaj, 1997. Introduction to Cytogenetics and Plant Breeding. Popular Book Depot, Chennai –15.
- Strickberger. M.W. 1996. Genetics. Prentice-Hall of India Pvt. Ltd. New Delhi.
- Singh, B.D. 2004. Fundamentals of Genetics, Kalyani Publishers, Chennai.

Web resources :

- www.nmsu.edu,
- www.biology200.gsu.edu

SAC 202 Soil Resource Inventory and Problem soils 1+1

Aim:

To impart proficiency to the students in exploring the problems and potentials of soil and water so as to decide the most appropriate land and water use.

Syllabus - Theory

Unit-I - Concepts of soil survey

Soil resource inventory - Early and modern concepts - Standard soil survey - Scope and objectives - Soil systematics - Soil mapping units - Methods and types of soil survey - Soil maps.

Unit-II - Soil taxonomy

Soil Classification - Earlier and genetic systems - Modern Soil Taxonomy - USDA System - Salient features, structure - Diagnostic horizons - Differentiating characteristics - Soil orders - Characteristics and distribution - Soils of India and Tamil Nadu.

Unit-III - Soil Survey Interpretations and Land Use Planning

Soil survey reports - Soil Survey Interpretations - Land Capability Classification - Soil and Land Irrigability Classification - Storie's Index Rating - Productivity potential - Fertility Capability Classification- Land suitability for field crops, horticultural crops and forest trees - Land Use Planning concepts and objectives.

Unit-IV- Soil constraints

Problem soils - physical and chemical constraints - Slow permeable, Excessively permeable, surface crusting, sub surface hard pan and fluffy paddy soils - Acid soils, Acid sulphate soils, ill drained and Aeolian soils and salt affected soils - Genesis, characteristics, effects on plant growth and management - Reclamation of problem soils .Polluted soils and their management.

Unit-V- Irrigation water quality and use

Quality of irrigation water - Criteria used for assessing the quality of irrigation water - Water quality appraisal - Effect of poor quality water on soil and crop growth.

Practical

Morphological study of soil profile - Study of base maps, aerial photographs and satellite imagery -Interpretation of soil survey data and maps. Nomenclature of soils- Estimation of CEC,

exchangeable cations and ESP. Analysis of problem soils - Lime requirement of acid soil — Gypsum requirement of sodic soils. Analysis of irrigation waters - pH, EC, TSS , anions and cations - Quality appraisal of irrigation waters and computation of salts. Field visit to problem soil area.

Lecture Schedule

1.Early and modern concepts of soil resource inventory, Concepts of Standard Soil Survey, its scope and objectives

2.Soil systematics - Characteristics of genetic horizons, subordinate distinctions, pedon, polypedon and control section, Soil mapping units - Soil series, soil association, soil complex, variants, inclusions and miscellaneous land types.

3.Method and types of soil survey - Free and grid survey, Reconnaissance, Detailed, Semi detailed, Exploratory and Rapid reconnaissance survey

4.Soil classification - Purpose, early, genetic and modern systems of classification

USDA Soil taxonomy - Structure and differentiating characters - Appreciation and Criticism.

5.USDA Soil taxonomy – Epipedons and Endopedons

6.Diagnostic organic materials, diagnostic soil characteristics - Soil moisture and Temperature regimes.

7.Soil orders - Characteristics and distribution in world , Soils of India and Tamil Nadu

8.Soil maps, kinds of soil maps and their preparation

9.Midsemester Examination

10.Soil survey report preparation and interpretation

11.Land Evaluation - Land Capability Classification (LCC)- Fertility Capability Classification (FCC) Soil and Land Irrigability Classification, Storie's Index Rating and Productivity potential - Land Suitability Classification

12.Land Use Planning - Concepts and objectives - Tropical, subtropical and Temperate regions.

13.Soil physical constraints - slow permeable, excessively permeable soils, Soil crusting, sub soil hard pan, fluffy paddy soil, shallow soil - Characteristics and management

14.Acid soil and Acid sulphate soils - Genesis and characteristics.

Lime requirement of acid soil, liming materials and reclamation / management of acid soil

15.Genesis and classification of salt affected soils - Effect of salts on plant growth, Saline soil, sodic and saline sodic soil - characteristics and their management

16.Aeolian , ill drained and polluted soils- Characteristics and their management

17.Quality of irrigation waters - quality criteria and appraisal- USSL and other systems--Effect of poor quality water on soil health, crop growth and management.

Practical schedule

1. Profile description
2. Estimation of CEC in soil- Part-I
3. Estimation of CEC in soil- Part-II
4. Estimation of Exchangeable cations and working out ESP
5. Estimation of lime requirement of acid soil
6. Estimation of gypsum requirement of sodic soil
7. Nomenclature of soil as per Soil Taxonomy
8. Land suitability for field crops, horticultural crops and forest trees
9. Estimation of pH, EC, TSS and chloride in irrigation water
10. Estimation of carbonate and bicarbonate in irrigation water
11. Estimation of sulphate in irrigation water by turbidimetry
12. Estimation of calcium and magnesium in irrigation water
13. Estimation of sodium and potassium in irrigation water
14. Classification of irrigation waters as per USSL and other systems

15. Computation of salts in irrigation water
16. Field visit to problem soils area
17. Practical Examination

Text Books

1. Sehgal,J. 2005. A Text Book of Pedology Concepts and Application, Kalyani Publishers, New Delhi
2. Brady, N.C. and Weil, R.C.2012.The nature and properties of soils.14th Edn,Pearson Publication
3. Soil Survey Staff, 2003. Keys to soil taxonomy, USDA, NRCS publication
4. Jean Paul Legros, 2013.Major soil groups of the world, Ecology, Genesis, Properties and Classification, CRC Press, Taylor and Francis, Florida
5. David Wynne Thorne and Howard Boyd Peterson, 2010. Irrigated soils, their fertility and Management, 2nd Edn in India, biotech Books, New Delhi
6. Richards, L.A,.1954, USDA hand book No.60, U.S.dept. of Agriculture
7. Thorne, D.W. and Peterson,H.B. 2010. Irrigated soils, their fertility and Management, 2nd Edn in India, biotech Books, New Delhi
8. Somani, L.L.1991.Crop production with saline water, Agro Botanical Publishers, Bikaner

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2. Eswaran, H., T.Rice, R.Ahrens and B.A.Stewart (Eds.) 2003. Soil classification: A global desk reference. CRC Press, Boca Raton, FL. *f-\ 7.* FAO, 2004. Soil salinity assessment. Scientific Publishers.
3. Field Book for Describing and Sampling Soils (Version 3.0). 2012. National Soil Survey Center, Natural Resources Conservation Service and U.S.Department of Agriculture.

4. Gupta, S.K. and I.C. Gupta 2014. Salt affected soils : Reclamation and Management. Scientific Publishers.
5. Gupta, I.C., N.C.S. Yaduvanshi and S.K.Gupta. 2012. Standard Methods for Analysis of soil, plant and water. Scientific Publishers.
6. Sehgal, J. 2005. Pedology concepts and applications, Kalyani Publishers, New Delhi.
7. Richards, L.A. 2012. Diagnosis and improvement of saline and alkali soils. Scientific Publishers
8. Sanchez, P.A., C.A. Palm and S.W.Boul. 2003. Fertility Capability soil classification: A tool to help assess soil quality in the tropics. Geoderma. 114:157-185.
9. Soil Survey Division Staff 1999. Soil Survey Manual, United States Department of Agriculture. Handbook 18. Soil Conservation Service.
10. Soil Survey Staff. 2006. Keys to Soil Taxonomy. United States Department of Agriculture, Natural Resources Conservation Service.
11. Somani, L.L. and K.L.Totawat 1993. Management of Salt Affected Soils and Water.
12. Sree Ramulu, U.S. 2003. Principles in the quantitative analysis of waters, fertilizers, plants and soil. Scientific Publishers.
13. Subramanian.S., G.V. Kothandaraman, S. Natarajan, and P.P. Ramaswami. 1987. Soil Survey and Land Use Planning for Watershed Management. Directorate of Soil and Crop Management Studies, Tamil Nadu Agricultural University, Coimbatore - 641 003.
14. USDA 1954. Diagnosis and improvements of Saline and alkali soils. (Ed) L.A.Richards. Handbook No.60. USDA Washington DC.

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4. www.iuss.org/Bulletins/00000096.pdf
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18. openaccess.icrisat.org/.../Proceedings-integrated-watershed-management-for-land-Asia.pdf
19. www.springerlink.corn/inde)(/ilu87tk58363.pdf
20. www.buc.edu.in/sde_book/msc_soil.pdf

Outcome:

The students will gain a comprehensive knowledge and skills in assessing land suitability for various agricultural and non-agricultural uses. Further, the knowledge and skill gained in this course can be applied by the students in solving / managing the soil related problems and poor quality irrigation waters.

ANM 201 Agricultural Nematology 1+1

Scope of the course:

The course on 'Introductory Nematology' will give an introduction about nematodes, its diversity, extent of damage caused in crops and the necessity to manage them in agriculture.

Objectives:

The course aims at imparting basic, fundamental and applied aspects of the science of Nematology at UG level.

Theory-Unit wise syllabus

Unit I: History and Development of Nematology, Importance of Nematodes and Beneficial nematodes

Introduction – Brief history and development of Nematology at National and International level – Position of nematodes in animal kingdom – Economic loss due to nematodes to crop plants. Beneficial nematodes. (entomopathogenic nematodes – *Steinernema* and *Heterorhabditis*)- Parasites of insects (*Mermis, Agamermis, Romanomermis).*

Unit II: Morphology and Taxonomy of Nematodes

Morphology and Anatomy of nematodes (cuticle, cephalic region, alimentary, excretory, reproductive and nervous system, sense organs) – Taxonomy of plant parasitic nematodes – Classification, of nematodes based on feeding habits.

Unit III: Symptoms, Interaction and Bio-ecology of nematodes

Symptoms of nematode damage – interaction with other microorganisms (fungi, bacteria and viruses) – Biology and ecology of important plant parasitic nematodes (*Meloidogyne, Heterordera, Rotylenchulus, Tylenchulus* and *Radopholus*) - Life cycle of important plant parasitic nematodes (*Meloidogyne, Heterordera, Rotylenchulus, Tylenchulus* and *Radopholus*) - Interaction with other micro organisms.

Unit IV: Nematode Management

Principles of nematode management –Legislative (plant quarantine), physical methods (soil solarisation, hot water treatment, seed cleaning); cultural methods – (deep ploughing, fallowing, solarization, crop rotation, antinemic plants - Host plant resistance to nematodes; biological control – nematode trapping fungi, egg parasitic fungi, obligate parasites, PGPR and predators - chemical control – soil fumigants - Non fumigants-mode of action—formulations-methods of application--Integrated nematode management.

Unit V: Nematode pests of crops

Major nematode parasites and management in cereals (rice and wheat), millets (sorghum, and maize), pulses (redgram, blackgram, greengram and cowpea); oilseeds (castor, groundnut and gingely), fibre crops (cotton), vegetables (tomato, brinjal, bhendi, chilli and potato, cole crops (cabbage, carrot, cauliflower), fruits (banana, citrus, grapevine, guava and papaya), spices and plantation crops (turmeric, pepper, betelvine and coconut), flower crops (crossandra, jasmine, and tuberose), Carnation, rose, gerbera, chrysanthemum, eustoma medicinal and aromatic plants, (medicinal coleus, geranium and patchouli).Beet root, sugarbeet, tapioca, tuber crops (yam, dioscorea).

Unit VI: Other roles of nematodes

Nematodes as bioindicators, nematodes as biological model, nematodes as dyssaprobes.

Practical schedule

Usage and handling of microscopes (binocular, trinocular, zoom and compound microspores) - Sugar floatation technique, Fenwick can method, Incubation and Blender technique - Nematode processing techniques -preservation, slow and rapid method of processing,

Making semi permanent and permanent slides - Morpholoy of orders *Tylenchida* (*Hoplolaimus*) and *Dorylaimida* (*Xiphinema*) - Identification of important nematodes (*Tylenchorhynchus*, *Helicotylenchus*, *Pratylenchus, Hirschmanniella. Hemicriconemoides*, *Criconema, Heterodera, Globodera, Tylenchulus* and *Aphelenchoides*) - Life stages of sedentary and migratory endoparasites.

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2. Ravichandra, N. G. 2008. Plant Nematology. L.K. International Publishing House, New Delhi. P. 688
3. Parvatha Reddy, P. 1986. *A Treatise on Phyto Nematology*, Agricole Publishing Academy, New Delhi, p.381.
4. Maggenti, A.R. 1981. *General Nematology*. Springer-Verlag, New York. 372 pages.

e-book:

Ronald N. Perry and Maurice Moens. 2006. *Plant Nematology*. CABI Publishing. 463 pages.